Deposits and Bank Capital Structure

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Motivation

Growing literature on the role of equity in bank capital structure focusing on equity as a buffer, liquidity, agency costs etc. (e.g., Diamond and Rajan (2000), Gale (2004), Morrison and White (2005), Hellmann, Murdock and Stiglitz (2000), Allen, Carletti and Marquez (2011))

Typically, partial equilibrium models take the cost of equity capital as given and higher than for other types of finance

- This means that banks economize on the use of capital
- There is scope for capital regulation imposing minimum capital requirements

Some papers have questioned whether this is justified and have stressed that the cost of equity should vary with capital structure (Miller (1995), Brealey (2006), Admati, DeMarzo, Hellwig and Pfleiderer (2010))
What we do in our paper

- We develop a **general equilibrium** model of bank (and firm) financing where the cost of capital is endogenized.

- Our aim is to analyze:
  - Optimal capital structure for banks
  - Implications for the pricing of equity and deposits

- Main results:
  - Capital is *costly* and Modigliani and Miller’s irrelevance result does not hold.
  - There is a **unique** optimal capital structure, which depends on whether:
    - Banks invest directly in risky investments
    - Banks give loans to firms
Baseline model: Direct investment

Capital ($K_B$)

Deposits ($1 - K_B$)

Bank

Risky technology

Uninsured  Insured

Extension: Lending to firms

Capital ($K_B$)

Deposits ($1 - K_B$)

Bank

Capital ($K_F$)

Loans ($1 - K_F$)

Firm

Risk technology

Public  Private
Main ingredients of our analysis

- We base our analysis on two main elements
  1. Banks raise funds from deposits, while non-financial firms do not. The markets for deposit and equity finance are segmented
  2. Banks and firms incur bankruptcy costs
Market segmentation and bankruptcy costs

- Deposit finance represents a large share of banks’ liabilities but it has played a relatively small role in the theory of bank funding
  
  - Deposit market is segmented from the equity market for households because of participation costs (Guiso and Sodini (2013)) and for businesses because it provides different services

- Bankruptcy costs are significant for both banks (James (1991) finds 30%) and firms (Andrade and Kaplan (1998) and Korteweg (2010) find 10-23% and 15-30%, respectively)
  
  - These results underestimate the real cost of bankruptcy (e.g., Almeida and Philippon (2007) and Acharya, Bharath and Srinivasan (2007))
The baseline model

- One-period model, where banks raise capital $k_B$ and deposits $1 - k_B$, and invest in a risky technology with return $r \sim U[0, R]$, with $E r = \frac{R}{2} > 1$

- There are two groups of risk neutral investors (each with endowment of 1):
  - Shareholders supply capital (or deposits) to banks with opportunity cost $\rho$. They can also invest directly so that $\rho \geq R/2$
  - Depositors supply deposits to the banks for the promised per unit rate $r_D$ and opportunity cost $u$. Their alternative is to store so that $u \geq 1$

- The two markets are segmented
The total supply of capital is $K$ and of deposits is $D$ with

$$\frac{K}{D} = \eta > 0$$  \hfill (1)

Since banks invest with risky return $r$, they repay depositors $r_D$ if $r \geq \bar{r}_B$, where

$$\bar{r}_B = r_D(1 - k_B),$$  \hfill (2)

and go bankrupt otherwise.

Liquidation proceeds are $h_B r$, with $h_B \in [0, 1]$, and are distributed pro rata to depositors so that each depositor obtains $\frac{h_B r}{1 - k_B}$.
The equilibrium with direct investment

1. Banks choose $k_B$ and $r_D$ to maximize expected profits
2. Capital providers maximize expected utility
3. Depositors maximize expected utility
4. Banks make zero expected profits in equilibrium
5. The equity market clears: $N_B k_B \leq K$
6. The deposit market clears: $N_B (1 - k_B) \leq D$
Each bank’s optimization problem

\[
\max_{k_B, r_D} E\Pi_B = \int_{\bar{r}_B}^{R} (r - r_D(1 - k_B)) \frac{1}{R} dr - \rho k_B
\]

subject to

\[
EU_D = \int_0^{\bar{r}_B} \frac{h_B r}{1 - k_B} \frac{1}{R} dr + \int_{\bar{r}_B}^{R} r_D \frac{1}{R} dr \geq u
\]

\[
E\Pi_B \geq 0
\]

\[
0 \leq k_B \leq 1
\]
Proposition

In the unique equilibrium with $h_B = 0$, $k_B \in (0, 1)$, $\rho > \frac{R}{2}$, $E\Pi = 0$, $N_B k_B = K$ and:

i) For $R < \bar{R} = \frac{4(1+\eta)}{1+2\eta}$, $EU = u = 1$ and $N_B(1 - k_B) < D$;

ii) For $R \geq \bar{R}$, $EU = u \in [1, \frac{R}{2})$ and $N_B(1 - k_B) = D$.

- Banks hold **positive** capital and there is a **unique** capital structure
- The opportunity cost $\rho$ is bid up above $\frac{R}{2}$ (and above $u$) so capital is **more costly** than deposits
  - Capital allows bankruptcy costs to be reduced and is scarce
  - Capital is always fully included in the banking sector, while deposits are not — financial inclusion may not be complete
- Results hold for any $0 < h_B < 1$
- Only with $h_B = 1$ (or $\eta = \infty$) a MM-type result holds and $\rho = \frac{R}{2}$
Corollary

The following comparative statics results hold:

i) \( \frac{\partial k_B}{\partial R} \leq 0 \), with the inequality strict for \( R < \bar{R} \)

ii) \( \frac{\partial \rho}{\partial R} > 0 \)

iii) \( \frac{\partial u}{\partial R} \geq 0 \), with the inequality strict for \( R > \bar{R} \)

iv) \( \frac{\partial R}{\partial \eta} < 0 \).

- Capital is (weakly) decreasing in \( R \)
- Shareholders capture all surplus for \( R \leq \bar{R} \), while surplus is split for \( R > \bar{R} \)
- The degree of financial inclusion increases with \( \eta \)
So far deposits are not insured so that $r_D$ reflects bankruptcy risk

- Capital has a role in reducing bankruptcy costs
- The market solution is efficient

If deposits are **insured** and $r_D$ is fixed, banks have no longer incentives to hold capital

Thus, there is a scope for capital regulation

- Equilibrium is similar to the market allocation ($\rho^{\text{reg}} > \frac{R}{2} > u^{\text{reg}} \geq 1$)
- But, lower capital ($k_B^{\text{reg}} \leq k_B$) and smaller deposit rate ($r_D^{\text{reg}} < r_D$)
- **Higher social welfare** is achieved because of $N_B^{\text{reg}} \geq N_B$ and lower bankruptcy costs ($\bar{r}_B^{\text{reg}} < \bar{r}_B$)
Lending to firms

- So far we have considered the case of direct investment.
- The more common view is that banks channel funds to firms through the allocation of credit. We consider two cases:
  - **Public firms**: they have no inside equity but can attract funds both from banks and outside equity investors.
  - **Private firms**: they have an initial endowment of inside equity but can only raise external funds in the form of bank loans.

Main take away:

- Results on the pricing of capital and deposits remain valid: 
  \[ \rho > R > u \geq 1 \]
- Capital structure of banks and firms change significantly in the two cases, but it remains unique.
Concluding remarks

We have provided a theory of the corporate finance of banks and firms based on

- Segmentation of deposit and equity markets
- Bankruptcy costs for banks and firms
  This provides
- A theory of "expensive" equity capital
- A theory of when banks hold positive capital and when not
- An important extension would be to endogenize the supply of capital and the supply of deposits